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BIOLOGICAL BULLETIN.

GUESTS AND PARASITES OF THE BURROWING BEE HALICTUS.

AXEL LEONARD MELANDER AND CHARLES THOMAS BRUES.

During the months of summer every roadside presents a field of busy insect-activity, as varied and interesting as it is unseen and unheeded. Those insects, however, that we do notice are seen during their idling moments and hence we are generally accustomed to stigmatize all as idlers with no aim beyond song or frolic. But insects have a busy life—another phase of their existence which many of us overlook. If we inspect some roadside more attentively we shall be surprised to see many of the self-same idlers working with diligence. Spurred by parental anxiety these insects excavate their nests and store them with food, doing for their young what their parents have done for them.

Out of this multiplicity of insect-life we shall select as an example one of the burrowing bees of the genus *Halictus*, and endeavor to tell what may be seen on any summer day. *Halictus* (*Chloralictus*) *pruinus* Robertson is a brilliant greenish bee, measuring about one third of an inch in length, which lives over an extended range, occurring from New Mexico, through Illinois, to Massachusetts. It is the commonest Halictine at Woods Hole, in the last-mentioned state, where the following observations were made. During the early part of summer these bees commence their excavations along the roadsides wherever a sandy slope presents a favorable situation, and continue their activities until early autumn, the colonies increasing in size, and becoming more closely settled as the season advances. They seem to be in the height of their vigor during the early part of September in this region. Although their social instincts are not so highly developed as those of *Apis* or *Bombus*, these bees

depart in their habits from the strictly solitary bees in that a male and two or three females are generally necessary for the successful direction of a single ménage. Moreover, a large number of nests are usually associated as a colony which may be scattered over a considerable distance or so populous that the tunnels almost intersect by their irregularities. The openings to the nests, however, are always separated by a distance of two or three inches or more. It can thus be readily seen that *Halictus* lives under conditions more or less similar to those of their more gregarious relatives, the ants, and hence it is not surprising that they are forced to harbor the same class of guests, and to be exposed to the same vicissitudes as are their cousins.

In constructing their nests the bees dig by means of their mandibles in the sandy clay, forming a hole of a diameter only slightly greater than will admit the largest female. The wall is then banked up with a plaster formed by the aid of saliva. Immediately behind the entrance is a short blind passageway, only large enough to allow a bee to turn on itself within.

This niche, which is always less than an inch from the entrance, serves simply to allow the bees to pass one another in the interior of the nest. From this point the gallery extends nearly straight back into the hill side, for a distance of a few inches and then slopes downward to the end — a total length of a foot or so. Near the further end jut a number of small diverticula radially extending from the main tunnel.

These are the nurseries of the young bees, where are stored the pollen and honey which is destined to serve as food for the bee larvæ of the coming generation. The excavation of the tunnels is a matter of considerable toil, requiring many days for its completion, but so industriously do the little bees work that at the close of day a miniature mound of sand has accumulated on the hill-slope below the opening. During the warm portions of the day the site of each colony of nests is a scene of inspiring activity. The air is filled with an ever-changing swarm of bees, each bent on its own task of excavation or of collecting honey and pollen, while from the openings of completed nests others can be seen peering about and eying everything that comes within their range of perception. At night everything is quiet, the trespass-

sers and robbers, too, have ceased their work, and the colony slumbers in peace.

The structure of the nest was ascertained by the ingenious plaster-cast method advocated by Prof. J. B. Smith. By this means the galleries of *Halictus* are seen to depart but little from those of the other burrowing bees. A passage-way for exit and entrance in addition to the regular one opening on the dumping ground, such as is constructed by *Augochlora humeralis* Patton,¹ was never noticed in the case of *H. pruinosus*, the vigilance required to guard two openings having probably prevented such an extravagance. All the burrows which we dug out, a dozen or so in number, extended in a nearly horizontal direction, and were always built on the very steep slopes along the roadsides. By

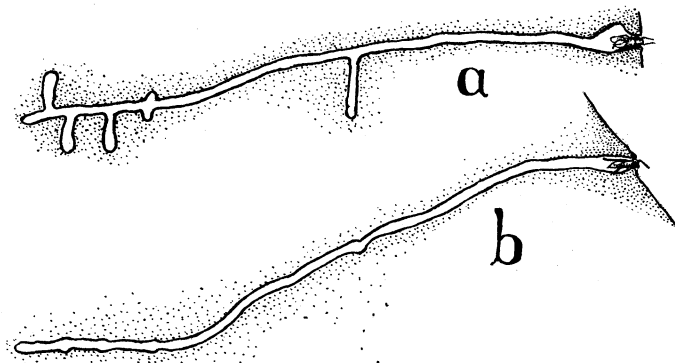


Fig. 1. Diagram of *Halictus* nest. a, plan; b, elevation.

this means none of the excavated dirt accumulated about the doorway, which was even cleared of all débris with but little effort on the part of the bee. The relatives of *pruinus* in Texas, morphologically of the same species, select a level spot for their nesting-site, dig vertical burrows, and place the accumulated dirt in an irregular cone about the opening. A photograph of these nests is given for comparison.

During the latter part of nest-construction when the pollen has been gathered and the eggs laid, their home is continually threatened by thieves and kidnappers against whom a guarded watchfulness must be maintained. The sentinels are generally the

¹ J. B. Smith, *Proc. Am. Ass. Adv. Sci.*, 1898, p. 368.

males, who sit at the doorway, their rounded heads neatly filling out the entrance. When the female returns pollen-laden, the little guard slips into the first side passage while she enters, and then as quickly returns to his post. The incomers are perceived at a distance of half a foot, probably announced by the buzzing of their wings. Even when the little watchers can not see the female coming they dart half way out of their retreat at her approach. With antennæ vibrating and mandibles spread the males either manifest a joyful greeting for their nest-mates or show an



FIG. 2. Nest of *Halictus* near Austin, Texas.

equal degree of hostility towards any stranger that may venture too near.

The most dreaded of the enemies of the *Halicti* is perhaps the little velvet ant, *Mutilla canadensis* Blake, which is common nearly everywhere in North America, running about on the nests of these bees, its distribution practically coinciding with that of this species. Perhaps it is the stridulation produced by the abdomen of these intruders that arouses the ire of the guard at the door, for no sooner does one approach a nest than the watcher, if it be a female, rushes out and pounces upon the *Mutilla*, endeavoring to sting it to death. Down the hill-slope they roll, heedless of everything but an inborn desire to annihilate each

other. The *Mutilla*, too, is armed with a powerful sting, half the length of her abdomen, but the sagacious *Halictus* grasps her enemy about the waist and most successfully evades the sharp thrusts. These combats continue for many minutes, concluded either by the invulnerable *Mutilla* slipping from the bee's grasp, for her body is hard and sleek, or by the death of the more plucky *Halictus*. Each colony, where everything seemingly is peace and content, is thus turned into a field of carnage, with the bodies of one or more females ruthlessly tumbled to the bottom of the hill. If the bee escapes unscathed, which happily is the more usual outcome of these struggles, she spends a few moments in preening her body, and then returns to her nest. But no

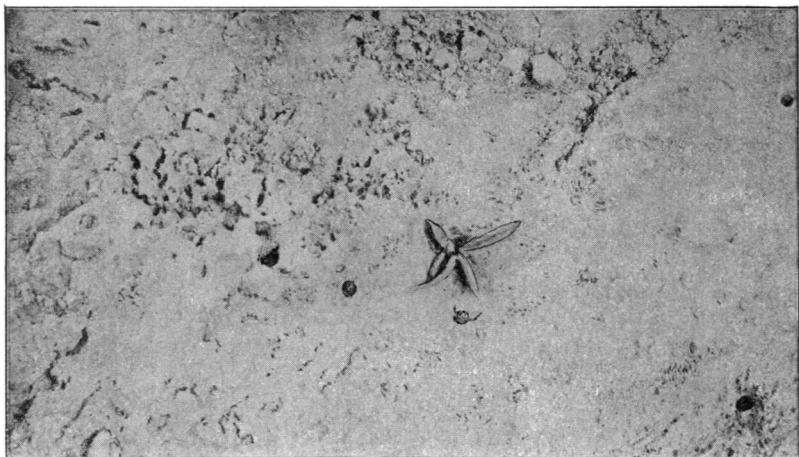


FIG. 3. Nest of *Halictus* at Woods Holl, Mass.

greeting awaits her after her loyal struggle. When she hurriedly left the nest the male waiting his turn in the tunnel below quickly took her place as guard at the door, and now he blocks the entrance as obstinately as though it were a stranger begging admittance. The taint of *Mutilla* is still to be recognized on the body of the female and probably overpowers her family smell. For quite a minute she must remain at the door parleying with her mate before he is convinced of her identity.

This observation is of interest when considering the organic dependence of instinct. Fear of *Mutilla* has been cultivated

through natural selection and heredity till it manifests itself in the actions just recorded. But the conduct of the male towards his nest-mate, an inhospitable act which a gleam of reasoning intelligence would not permit under the circumstances, lends itself rather to the theory of a mechanical instinct, actuated in this case by the chemical nature of *Mutilla's* poison. If this be so it will be questioned why the bee does not behave as when *Mutilla* itself approaches. Does the mixture of *Mutilla*-influence and *Halictus*-influence compel an impassive head-on greeting while

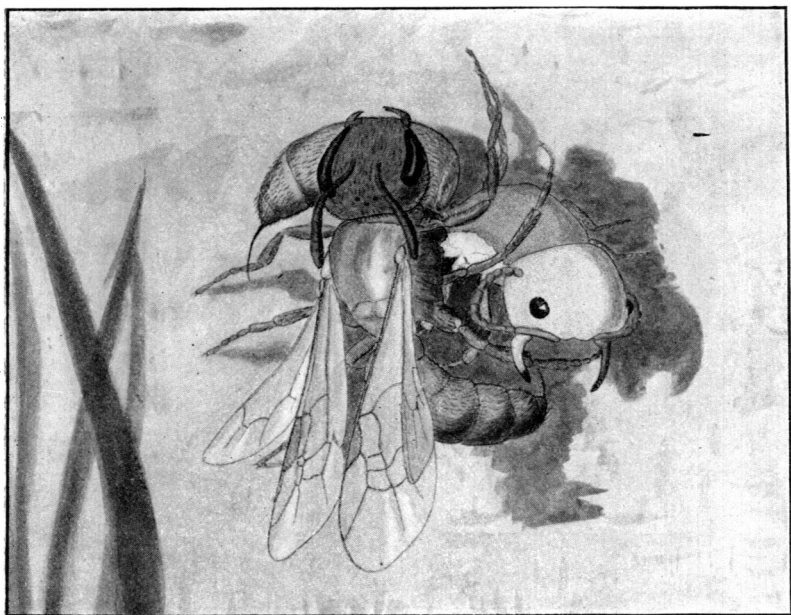


FIG. 4. Combat between *Mutilla* and *Halictus*. "Down the hill they roll heedless of everything but an inborn desire to annihilate each other."

Mutilla alone induces the male-watcher to turn tail in the manner described on the next page?

One little bee once displayed an originality not noticed again. For fully twenty minutes she had waited at the entrance of her home, gently urging admission by advancing to the nest-opening once each minute. The male would retreat a short distance each time but not sufficiently far to admit the female, who would then retire, resting with her antennæ almost touching those of the

stubborn gate-keeper. Finally she turned about and crept backward to the male, resting a moment with her sting before his face. When she now turned, the male seemed convinced, and the wearied female entered in the usual way. In this case did the female flaunt her own poison to overcome that of *Mutilla* as a passport to her home? It might seem so; but the simplicity of such a physiological action is quite equalled by the complexity of the intelligence displayed.

When a male bee guards the opening the approach of *Mutilla* produces a far different effect upon the watcher. Instead of rushing out on the marauder, the defenseless male adopts the less foolhardy measure of "turning tail," but still keeps at the entrance of the nest. Now the convex abdomen neatly fits the opening, forming a parasitic-proof shield, and *Mutilla* must needs leave. When no other bee is behind a female watcher, she never rushes out, leaving the nest unguarded, but adopts a manœuvre similar to the male's, but instead of inflexibly curving her abdomen over the opening, she reaches afar with her sting.

Canadensis, however, is not the only Mutillid that worries the Halictines. On numerous occasions *Myrmosa unicolor* Say¹ and *Mutilla infensa* sp. nov. were found crawling about, but these species do not appear to have become nearly so annoying. From one square meter of *Halictus*-colony fully fifty specimens of *canadensis* were taken during the summer, whereas in all but ten specimens of the *Myrmosa* were observed. *Mutilla ferrugata* Fabr. and *vesta* Cresson were also found prowling over the nests, though these species are doubtless parasitic on the larger burrowing insects which associate with *Halictus*, for the large size of their bodies would not permit entrance into the *Halictus* nests. Moreover, they may crawl quite close to the doorkeeper and elicit no attention; possibly their stridulation is pitched to an unresponsive key and their odor stimulates no reaction.

Almost as ardent a persecutor of the bees is to be found in a

¹ It is time to abandon superfluous names. *Myrmosa unicolor* Say, described as a male, and *M. thoracica* Blake, described as a female, have paraded in collections quite long enough as distinct species. Inasmuch as Mr. H. L. Viereck has recently taken the initiative (*Ent. News*, 1902, p. 72) in consolidating some of the species of Mutillidæ, we shall follow him in the nomenclature of this paper. The males of this species fly abundantly among the roadside flowers, in company with males of *canadensis* and *ferrugata* (= *castor* Blake = *Lepeleteri* Fox [*fenestrata* Lepeletier]).

new species of *Phora*.¹ This little fly takes a stand near an opening and patiently awaits an unguarded moment. Then she quickly slips in to deposit an egg in the pollen so industriously stored. One *Phora* persisted in her attempts to enter for several hours. Driven back a half inch by the doorkeeper she gradually and slowly returned until she nearly touched his face. Then a sudden lunge half way out of the nest on the part of the bee would drive her back again. This was repeated over and over, the doggedness of the parasite and her slow approach seeming to exasperate the little watcher. By turning his head he tried to follow her movements, but from their very slowness was unable to discern her position. Only when his palpi were touched would he make a sudden dart. *Phora* depends on her agility as well as on her deliberateness. On each return of the female bee, after a fifteen-minute foraging trip, the parasite would jump about excitedly and possibly would get a chance to oviposit on the pollen mass during a dart at the bee. A moment's rest on the threshold would grant the nervous little fly ample time to infect the unsuspecting bee. The behavior of the bees towards *Phora* is quite different from the action of ants towards these guests. Unless irritated by the persistence of the parasite, *Halictus* is passive and does not notice its presence. Even the incoming females do not see the fly at a distance of half an inch. On the other hand, ants are put in a state of fright by the proximity of these flies. During the attacks of the ant-decapitating phorid, *Apocephalus Pergandei* Coq. upon the species of *Camponotus*, *ferruginea* in the north, and *maculatus* var. *sansabeanus* in the south, the ants rush in the wildest excitement with wide-spread mandibles at the agile fly. Can this difference result from the bees never seeing their offspring and being consequently unaware of their fate, whereas the ants have a personal acquaintance with the ravages of these parasites? It might seem so, but we must remember that in the case of *Pachycondyla harpax*, at least, a phorid larva is not only tolerated in the nest, but is also fed by its host.² In this case, however, no harm is done to the species by the presence of the fly, whereas with *Halictus* it must mean the death of the brood.

¹*P. halictorum*, described in the sequel.

²Wheeler, W. M., *Am. Nat.*, 1901, p. 1007 et seq.

The most conspicuous of the smaller Hymenoptera that frequent these grounds is a little species of *Loxotropa*. Time and again this insect was observed crawling stealthily over the nest-colony, tapping its antennæ on the ground as it moved. During this deliberate progress it covers an inch in four seconds, but as soon as it nears a selected opening its movement slows down to an almost imperceptible advance. Still holding its long and clubbed antennæ extended straight forward, their tapping now reduced to a slight nervous vibration, it gradually insinuates itself into the nest, even beneath the very jaws of the gatekeeper. Often after crawling so far into the nest that only the tip of its abdomen is visible, it finds the nest unsuitable. Then it deliberates no longer, but makes a hasty exit, leaving the astonished

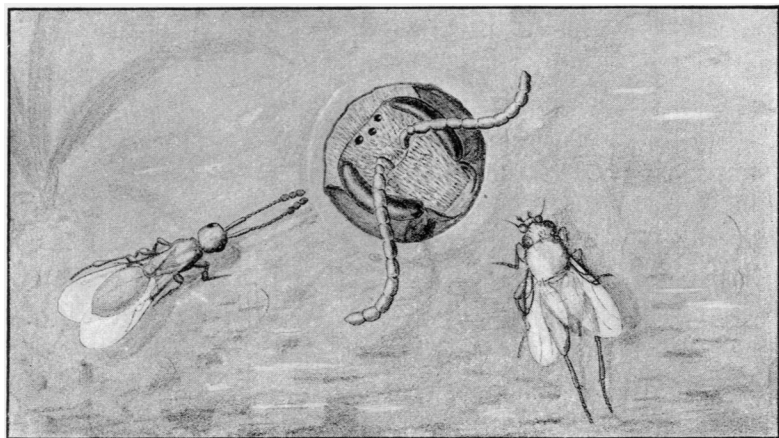


FIG. 5. *Loxotropa ruficornis* Ashm. *Halictus*, ♂. *Phora cata*, sp. nov.

sentinel to reach in vain with questioning antennæ for its bold and impudent disturber.

As interested an observer of the incoming bees as is the *Phora*, is a tachinid fly. This species hovers over the breeding ground and suddenly circles over a particular hole. Is it attracted to the nest by the hollowness of the sound of its vibrating wings as it flies over an opening, or does it discern the state of advancement of the household below by an instinct less mechanical? Like its relatives, this species chooses the moment when the incoming bee pauses at her threshold quickly and quietly to oviposit on her pollen mass and thus infect her offspring.

A number of ants, foragers from near-by nests, are always to be found on the nesting-ground. These belong to harmless species which do not molest the bees. When an ant and a bee meet on the nest there is no encounter, each retreating good-naturedly to go her own way. The *Stenammus*, especially, have a stridulatory note as plaintive as that of *Mutilla*, yet this is unnoticed by the bees; even the watchers rest unaroused in their doorways while the ants pass them by. The little red thief ant is also found nesting in the midst of the bee-colony. Evidently it is here to ply its vocation of tunnelling into the chambers of the bees to steal from them their honey.

The little beetle, *Bæocera concolor*, seems quite at home with the bees. Although it belongs to a family of fungus-beetles, it, nevertheless, must have some intimate connection with the bees, as it was repeatedly observed running familiarly in and out of the nests. It is quite possible that it may live upon the pollen in deserted nests which has become mouldy by the growth of fungus hyphæ. The mixture of pollen and honey is thus readily turned into a mass of fungus under certain conditions.

The woes of the Halicti are not yet at an end. Another insect is as persevering in its depredations as its colleagues, and accomplishes by boldness what the others try by stealth. This is a larger foe, *Philanthus punctatus* by name, which audaciously builds its nest in the center of the *Halictus* colony, and when ready swoops down on a bee, stings it to death, and carries it home. Not one but many bees meet this death at the sting of their unsuspected neighbor, who plans her murders so that they take place at the flowers where the bees are at work.

When we consider the persistence of the *Mutillas* we can appreciate the extent to which specialization in keeping the nest parasite-proof has been carried by this bee. Seldom are the entrances left unguarded, and never is a stranger bee granted admission. In this respect *Halictus* is far more conservative than the wasp *Trypoxylon*. Although mistakes in selecting their own domicile from a cluster of fifty similar nests were frequently made, the watchers always recognized these visitors as strangers and were instantly ready to show fight. *Trypoxylon*, a wasp which also guards its doorways, on the contrary, makes no ob-

jection to the free entrance of visitors of the other sex, as has been shown by the Peckhams.¹ *Mutilla canadensis* appears to be the most dreaded enemy, as it alone is noticed by the bees. With a little reasoning ability many of the other parasites could be readily annihilated, whereas no move is made for protection against these foes except by the guard at the door. But how are the bees to know, even in the case of *Mutilla*, that their guests mean harm to their progeny? Probably they do not in a strict sense. It is evident, however, that the instinct of guarding the entrance to the nest could have been developed through the

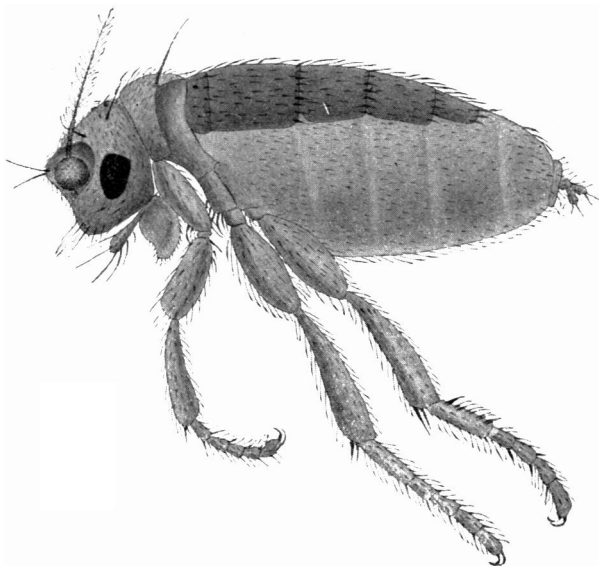


FIG. 6. *Stethopathus occidentalis*, sp. nov., lateral view.

action of natural selection of favorable variations in habit, while it would be difficult to derive a number of specific reactions towards the different guests in the same manner. The very commonness of *Mutilla* and its conspicuous size are probably the reason that a specific reaction has been developed in this single case. *Halictus* is far less sensitive to its surroundings than many of the fossorial wasps are, coming and going even though we dis-

¹ "Instincts and Habits of the Solitary Wasps," p. 79, 1897.

turbed the nest and remained close by. Its one fear is centered in *Mutilla*. With thief-ants to rob its nests, parasites to prey on its offspring, and in constant danger of being carried away bodily by a wasp, itself numerous in individuals, it is remarkable that *Halictus* should have become a dominating type throughout such a wide territory.

This ends the list of the enemies of the bees as we have observed them. Many other insects abound on the nesting-site, but most of these, at least, are accidental visitors which neither harm nor are harmed. Several beetles, spiders, flies and other insects are included in this list which we give for reference in conclusion. The smaller species live near the *Halictus* as they would do anywhere, and not through preference, and the larger ones in part are attracted to our observation ground to prey on the smaller. These transients are such as a careful observation of any limited field would bring to notice. They are the participants in life's continual struggle, each seriously and unwittingly playing its part.

PART TWO.

A LIST OF THE INSECTS, INCLUDING THE ACCIDENTAL VISITORS,
FOUND ABOUT THE COLONIES OF *HALICTUS PRUINOSUS*,
ROBERTSON, AT WOODS HOLE, MASS.
JULY-AUGUST, 1902.

Class ARACHNIDA.

Epeirid sp.

A minute larval spider was several times seen. It has no connection with the *Halictus*.

Bathypantes formica Emerton.

Quite a number of specimens of this strange spider were observed running in their zigzag course over the ground. Like the last it is an accidental visitor, occurring on the colony during its search for food. We are indebted to Mr. Nathan Banks for the determination of this species.

Acarina spp.

Two species of mites were obtained, one of which (*Bryobia pratensis* Garm. ?) occurred in numbers.

Class MYRIAPODA, DIPLOPODA.***Polyxenes fasciculatus* Say.**

Numerous specimens found crawling about on the sand.

Class INSECTA.**Order Thysanura.**

The genus *Podura*, represented by many specimens, was found associated with the former.

Order Hemiptera.***Aleurodes* sp.**

The larval form of an Aleyrodid was discovered on the nest. Probably it is that of *A. corni* Hald., the commonest form of the Atlantic States.

Order Diptera.**Family CHIRONOMIDÆ.*****Ceratopogon hollensis* sp. nov.**

Third vein in part confluent with the first, ending much beyond the middle of the wing, wings in large part hairy, not uniform in coloration, but not spotted; eyes well separated; tarsal claws simple, of an equal length; legs not spinose beneath; metatarsus much longer than the second tarsal joint.

Female. — Head fuscous, proboscis black. Antennæ fuscous, the joints uniformly moniliform, slightly longer than broad, the last two joints longer. Eyes widely separated, the front yellowish. Mesonotum pruinose, sparsely and uniformly covered with short black bristles. Abdomen dark fuscous, lightly gray pruinose, apically hairy. Pleuræ paler fuscous, smooth. Halteres dark fuscous, the stems paler. Legs slender, uniformly yellowish, except that the knees, and the tips of the femoral and tarsal joints are very narrowly black; tibiæ provided with several simple long but slender hairs on the outer edge; no bristles below, tarsi somewhat hairy, claws small, uniform, simple, empodium small. Wings sparsely covered with short bristle-like hairs, more or less serially arranged. These become obsolete at the very base, cinerascens with a pale brown tinge becoming stronger along the basal part of the course of the anterior heavy veins, gradually interrupted in front of the anterior cross-vein, then gradually recommencing

to end abruptly before the tip of the first vein. The crotch of the furcation of the light vein crossing the anterior cross-vein is darkened by an accumulation of pigment and by an increase in the number of hairs.

Length, 0.85 mm.

Woods Hole, Massachusetts, August, 1902.

The nearest relative of this species is *C. variipennis* Coq.

It is not unlikely that the species is an halictophile, as it was several times seen upon the nests, thus suggesting its myrmecophilous relatives. It may also be the cause of the presence of some of the proctotrypidæ here listed, as some of them are known to prey on the larvæ of various species of the genus. This is the case with *Adeliopria* Ashm., a Diapriid, which is parasitic on a Texan species of *Ceratopogon*.¹

Family MYCETOPHILIDÆ.

Sciara sp.

A *Sciara* would frequently fly over the nesting-site and alight on the open ground. It is an accidental visitor more at home in the nearby grass.

Family PHORIDÆ.

Phora halictorum sp. nov.

Female.—Length, 1.5–2.25 mm. Head black, subshining, antennæ black; palpi dull yellow, with stiff black bristles below; proboscis not exerted; front long, flattened, punctured, shining, its bristles reduced in size, and those of the middle row placed high up. Anterior four proclinate bristles small, the remaining ones placed normally.

Thorax black, subshining, the dorsum finely pubescent, the pleuræ lightly pruinose, ten bristles present on the hind edge of the mesonotum, dorsum with one pair of dorsocentral and four marginal scutellar bristles.

Abdomen black, shining though not brilliant, not bristly, lightly pruinose basally along the sides; ovipositor short, retractile, piceous.

Legs piceous, front legs somewhat lighter, front coxæ dull yellowish, middle and hind coxæ piceous, hind coxæ with the usual ridge on the posterior side; hind femora stoutest, twice as thick as the front ones, middle femora intermediate, all the tibiæ with short bristles, biserially arranged on their outer side, those of the front tibiæ ten to twelve in number and approximated into one line towards the inner forward edge, those of the other tibiæ in two separated series, for the middle tibiæ four in the outer and six in the inner row, and for the hind tibiæ seven in the outer and ten in the inner rows; front tibiæ without terminal spurs, middle tibiæ with one

¹ See Wm. H. Ashmead, *Biol. Bull.*, 1902, p. 15.

long spur three fourths the length of the metatarsus, hind tibiæ with two moderately long spurs, the outer one two-thirds as long as the inner, which is nearly as long as that of the middle tibia.

Wings hyaline with faint cinereous tinge, not brilliantly iridescent, the heavy veins nearly black, reaching very nearly to the middle of the wing. First vein but slightly bowed, third vein nearly straight, furcate, costal bristles fine and short, thickly placed, distributed as follows: four proximal to the humeral cross vein, twenty-two (double series) bordering the costal cell, ten (double series) bordering the marginal cell, and six (in double series) along the submarginal, *i. e.*, the furcation of the second heavy vein. Thin veins dark, the fourth longitudinal slightly flexed only at its extreme base, so that the cell in front is slightly wider than the one behind, ending a little closer to the wing-tip than the second light vein does, seventh vein evident, extending into the wing-margin. Halteres whitish, their stem dusky.

Male.—Length, 1.75 mm. Differs as follows: frontal bristles stouter, abdomen smaller, genitalia not distinct, small, the central filament fleshy, short, directed backward. Tibial setulæ and the inner spur of the hind tibiæ reduced in size, ridge of the hind coxæ large; costal bristles not uniform, disposed thus: prehumeral four, twenty along costal cell, four along marginal cell and four along the submarginal. The inner bristles are minute, becoming larger at the third pair of the costal cell, and from thence are much stronger than in the female.

Described from several specimens, collected as described in the previous account at Woods Hole, Mass., July–August.

This species is related to *agarici* Lintner¹ but differs by the longer bristles on the tibiæ, longer front, four scutellar bristles, etc. The habits also are quite different, as *agarici* feeds upon decaying mushrooms.

***Phora rostrata* sp. nov.**

Female.—Length, 1.5–1.75 mm. Black, shining, legs more or less yellow, lower frontal bristles proclinate, third vein forked.

Head shining black, especially smooth and polished on the front and vertex. Front with the normal chætotaxy except that there are only two proclinate bristles at the lower edge. The front is also sparsely hairy besides the large bristles. Median longitudinal groove and ocellar tubercle unusually well-marked. Antennæ black, with a distinctly plumose arista. Proboscis piceous, very large and strongly exerted, as long as the head-height. It is slender at the base where the rather small bristly spindle-shaped black palpi are inserted, then much enlarged, swollen and bifurcated at the extremity. The bifurcation is produced by a splitting of the apex by a horizontal slit in the proboscis. Thoracic dorsum shining, hairy as usual,

¹ Roth N. Y. Rept., pp. 399–406.

with one pair of dorsocentral and two scutellar bristles. Abdomen black, nowhere bristly. Legs pale yellow, the tarsi sometimes brownish; hind tibiæ very indistinctly ciliated and with a single weak spur, as have also the middle pair. On the inner side at the apex the posterior pair have several transverse rows of short black bristles. Wings yellowish hyaline, the costal vein reaching distinctly beyond the middle of the wing and with very short cilia. First vein ending a little closer to the tip of the second than to the humeral cross vein. Fourth vein evenly arcuate, fifth vein sinuate as is also the sixth; seventh vein present. Halteres yellowish, blackened at the tips.

Described from two female specimens collected at Woods Hole, Mass., July 15, 1902, about the burrows of *Halictus prunosus*.

This species is readily recognizable on account of the excessive development of the proboscis, which is evidently adapted to some peculiar method of food-getting. It is also characterized especially by the very shining front, which seems to place it near to the European *P. minor* Zett., with which it agrees in some other characters.

***Phora cata* sp. nov.**

Male and Female. — 0.8–1.2 mm. Black, legs and palpi yellowish or brown, antennæ of male enlarged. Anterior frontal bristles proclinate.

Head black, front short, about as wide as long, subshining, faintly gray pollinose in the male, two anterior bristles proclinate, the others all present and arranged as usual. Antennæ wholly black in the male, in which sex the third joint is enlarged and ovate so as to be very conspicuous, in the female they are of the usual size and slightly yellowish at the base; arista pubescent. Palpi light yellow, strongly bristly. Proboscis of female projecting, stout and horny. Thorax shining, black, hairy, with one pair of dorsocentrals and two marginal scutellar bristles. Abdomen black. Legs yellowish-brown, the anterior pair lighter. Posterior femora ciliated below on apical half, their tibiæ without any rows of small bristles on the outer side; four posterior tibiæ each with a delicate apical spur. Wings hyaline, the costal vein not quite reaching to the middle of the wing, its cilia short and closely placed. Third vein far from the costa at its base, and forked very near the apex. Tip of first vein twice as far from the humeral vein as from the tip of the second. Fourth vein slightly but evenly curved, re-curved at the extreme tip. Fifth slightly diverging from the fourth to its tip, which is as far behind the wing tip as the fourth is before it. Seventh vein faint but distinct. Halteres yellowish in the female, piceous in the male.

Described from a single pair from Woods Hole, Mass. The lighter color of the female is most likely due to her apparently

immature condition. They were taken on the sand in the midst of a colony of *Halictus*.

This species can readily be recognized in the male sex by the enlarged third joint of the antenna. The female is not so characteristic, but can be distinguished by the combination of structural characters given in the description. It resembles most closely *P. agarici* Lintner, but has very short costal bristles.

Stethopathus Wand.

Among the insects frequenting the ground immediately about the *Halictus*-burrows was one extremely small form, which from its quick motions we immediately suspected to be a wingless phorid fly. Such it indeed proved to be, but of quite a different sort from any of our previously discovered North American species. Its occurrence in New England is quite unexpected and considerably extends the range of such forms, as none have hitherto been seen in America north of central Texas.

Its associations with the *Halictus* may be doubtful, although no specimens could be found elsewhere whereas three females were captured where the burrows of the bees were abundant. Nests of *Lasius niger* and of *Stenamma fulvum*, variety *piceum* also abound in such locations, but close scrutiny of the ant nests revealed no specimens of the Phoridae. The fact that species of *Phora* occur as parasites of these bees would make it seem not improbable that the *Stethopathus* has similar habits. We have also a single winged male phorid, captured at the same time, but which is probably the male of some other undescribed form on account of its larger size and the different chaetotaxy of the head. The description of this interesting little wingless fly, one of the smallest known of all the Diptera, is given herewith.

Stethopathus occidentalis sp. nov.

Female.—Head rounded triangular, much rounded on the sides and at the hind angles and obtusely pointed in front, about two thirds as long as wide above, vertex descending rather steeply and evenly. Eyes small, about one and one third times as large as the second antennal joint, coarsely faceted with hemispherical ommatidia as usual. Antennae placed at the bottom of the deep frontal cavities. Proboscis long and stout, equal to the head-height; palpi small and slender, thickest near the tips, with stout macrochaetae on the inner side. Ocelli present, placed in a small

triangle on the vertex. Head with four closely approximated macrochætæ at the middle of the front margin, two widely-separated ones near the anterior corner of the eye directed inwards and two outwardly directed ones near the posterior angles; a series of small macrochætæ below and in front of the eye.

Thorax small, twice as wide as long, truncate before and behind; sinuate on the sides and narrowed behind, so that the pleuræ are slightly visible from above. Thorax rather sharply arched above, and much narrowed below on the sides. Dorsal surface with a pair of long macrochætæ just

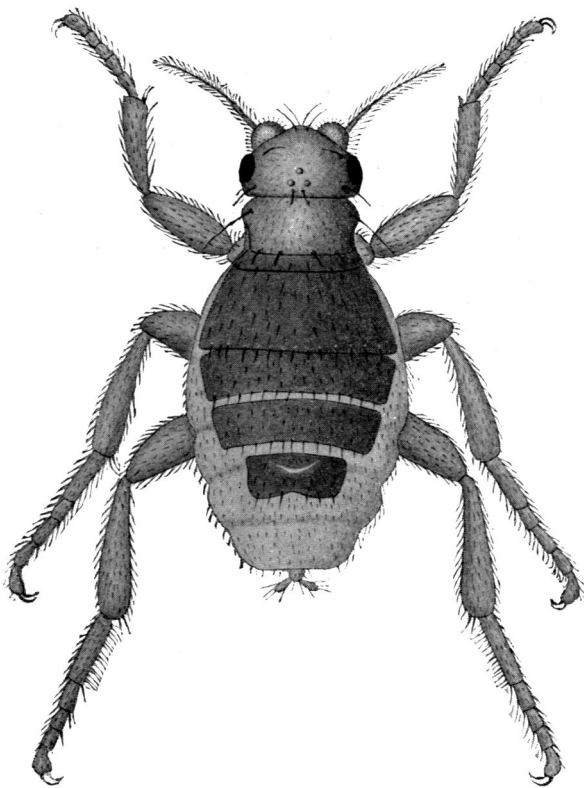


FIG. 7. *Stethopathus occidentalis* sp. nov., dorsal view.

behind the anterior angles and four smaller marginal ones along the posterior edge.

Abdomen considerably swollen, but with large and strongly chitinized dorsal plates. The first is only a narrow band, contiguous with the second which is very large and contiguous with the third. The fourth and fifth are separated by a white membrane such as covers the abdomen elsewhere. Seen from above the abdomen is twice as wide as the thorax and

flattened, oval in cross-section. No ventral sclerites are present. Each segment is margined behind with small bristles and is hairy elsewhere as is the entire body. Glandular opening of the fifth segment¹ in the shape of an arcuate slit. External genital organs of the usual form. Legs rather stout, the tibiae with two apical spurs.

Length, 0.75 mm. Testaceous, head and thorax darker above, especially directly about the ocelli. Abdominal plates dark fuscous, the membranous parts almost white, with a small fuscous spot at the insertion of each hair.

This form is a typical representative of the Stethopathinae and strange to say, it approaches more nearly to the East Indian *Stethopathus ocellatus* Wand. than to any of the species that have hitherto been discovered in America. Indeed, it is here regarded as congeneric with the former, although the two species are from such widely separated regions of the earth.² It may be necessary later to separate these two forms, but at the present state of our knowledge of this group it does not seem advisable. The American species resembles *S. ocellatus* Wand. in possessing ocelli, being utterly destitute of wings and halteres, and in having a similarly shaped head and abdomen. But differences in form are also evident: the thorax is only twice as wide as long, instead of three times as in *ocellatus*, the palpi are clavate, not spindle-shaped, and the chaetotaxy is somewhat different, although conforming to the same general type. Although its habitus seems to be quite different from that of the genus *Enigmatias* Meinert (which it may be recalled, has just been discovered in Arizona,³ a locality quite distant from its home in Denmark), yet this species may possibly prove to be a close relative.

A point perhaps of minor importance, but nevertheless interesting as bearing upon its systematic position, is the fact that the

¹ In previous papers the gland opening has been referred to the fourth segment of the abdomen, but the very short first segment in the present species leads us to believe that this sclerite is concealed in the other American species and that there, too, the gland really opens on the fifth segment.

² Many cases might be mentioned of monotypical or very small genera of insects which have an inexplicably wide discontinuous distribution. *Amphisoa* with two species, one in western North America and another in Tibet; *Syntelia*, which is represented by two species, occurs in Mexico and eastern Asia; and the water-beetle, *Pelobius*, occurring in western Europe, Tibet and Australia. For further references to the close approximation in certain details of the faunae of eastern North America and Asia, see C. C. Adams, "The Southeastern United States as a Center of Geographical Distribution of Flora and Fauna," BIOL. BULL., Vol. III., pp. 115, et seq.

³ D. W. Coquillett, *Can. Ent.*, 1903, p. 20.

American species has, like the East Indian form, bare, non-pubescent macrochætæ, while the other American species of this subfamily have them pubescent.

Family TACHINIDÆ.

Metopia leucocephala Rossi.

The interested observer of the *Halictus* mentioned in the first part was captured for identification, and proves to belong to this widely distributed species.

Order Hymenoptera.

Family BRACONIDÆ.

Subfamily CHELONINÆ.

Chelonus brevipennis sp. nov.

Female.—Length, 2 mm. Ferruginous, head piceous black, wings reaching just beyond the base of the abdomen.¹ Antennæ 21-jointed, tapering as usual, and almost as long as the body, ferruginous at the base, black at the tip, the third joint four times as long as thick, the apical joints more or less quadrate-moniliform. Eyes smaller and less densely hairy than usual. Head almost smooth above, shining, thinly pale pubescent, piceous black above, ferruginous below, palpi yellow. Thorax ferruginous, pronotum coarsely rugose reticulate above, mesonotum less distinctly so, metanotum small, quadrate, not toothed at the posterior angles, rugoso-reticulate; pleuræ not roughly sculptured, somewhat shining. Abdomen with no traces of sutures above, dark ferruginous and sparsely white hairy; gradually broadened from the base and rounded at apex; finely and irregularly reticulately striate longitudinally, especially at the base. The incurved margin is emarginate at the apex of the abdomen. Ovipositor stout, black. Legs long and slender, yellow, the femora clavate.

Described from a single female specimen collected at Woods Hole, Mass., in a burrow of *Halictus pruinosus*.

The present species seems best referable to *Chelonus* because of its pubescent eyes. The apex of the abdomen however is emarginate, somewhat as in *Gastrotheca* Guérin. Unfortunately as the wings are rudimentary they can not be used to determine its affinities. The only other apterous species belonging to this subfamily are included in *Acamptis* Wesmæl, from which the present form differs by its unsegmented abdomen.

¹ For neurulation, see BIOL. BULL., 1903, p. 189, Fig. 5.

Family CHALCIDIDÆ.¹**Eupelmus rhizophelus** Ashmead.²

This remarkable chalcidid with vestigial wings in the female was seen rather commonly about the *Halictus* burrows. As it has been previously bred from cynipid root galls by Mr. Ashmead, it is no doubt an accidental visitor to the bee nests.

Eupelmus Ashmeadii sp. nov.

Female. — Length, 3.5–4 mm., ovipositor 0.5 mm. Shining green varied with ferruginous on the thorax and with luteous and black on the abdomen. Head shining green, with a sparse white pubescence. Mandibles brown, black at the tips, palpi black. Antennæ long, the scape yellow, reaching to the ocelli, flagellum black, about once and one half the head-height, last joint acutely pointed. Head less than twice as wide as long, the space between the eyes above narrow, so that the lateral ocelli are close to the eye-margin. Face rugoso-punctate with a median carina extending from the clypeus to the insertion of the antennæ. Prothorax shining brown. Mesonotum very closely punctate, not at all shining, brown in front and green behind, concave medially behind, on each side of the depression it is raised and almost carinate, then slopes down to the reflexed margin; anteriorly it is raised to form a broad triangular tubercle. Pleuræ ferruginous except in front where they are green. Metanotum golden, closely punctate, bilobed, sharply declivous, forming a right angle with the mesonotum. Wings deeply infuscated, paler at base and slightly so at apex, with a narrow cross band of white just before the stigmal vein. Marginal vein equal to one third the length of the wing, stigmal vein moderate, one half the length of the post-marginal. Abdomen shining black, pale luteous on the basal third. Sheaths of the ovipositor bright ferruginous, almost as long as the abdomen. Legs brown, darker on the front and hind femora, tarsi yellowish except the tips.

Described from three female specimens collected at Woods Hole, Mass., July and August, 1902.

This pretty species was associated with the much smaller brachypterous species, *Eupelmus rhizophelus* Ashm., on the burrows of *Halictus pruinus*. It is named in honor of Mr. Wm. H. Ashmead, who determined it as an undescribed species.

Henicopygus subapterus Ashmead.

We have seen this species running actively about on the ground among *Halictus* burrows at Austin, Texas. Like the species of *Eupelmus*, it may be an accidental visitor.

¹ We are indebted to Mr. Wm. H. Ashmead for his kindness in determining the species of Chalcididæ.

² For wing-neuration, see BIOL. BULL., 1903, p. 189, Fig. 7.

Encyrtinæ gen. et sp. indesc.

Among the Chalcididæ there is a single specimen which Mr. Ashmead, who has kindly examined it, informs us represents an undescribed genus of Encyrtinæ. Unfortunately it is too poorly preserved to permit of an accurate characterization in the large and difficult group to which it belongs.

Cirrospiloideus (Miotropis) platynotæ Howard.

A single female of this species was captured.

Superfamily PROCTOTRYPOIDEA.

Family SCÉLIONIDÆ.

Telenomus sp.

There is a single pair representing an apparently undescribed species in this large and difficult genus.

Caloteleia Marlattii Ashmead.

This active little species is a regular visitor about the nests.

Caloteleia parvipennis sp. nov.

Female. — Length, 2.5 mm. Yellow, varied with darker. Head black, very smooth and polished above the antennæ, finely punctured on the vertex and with larger punctures intermixed. Mandibles yellow at the base, black at the tip. Antennal scape pale yellow, reaching a little above the vertex, the pedicel small and rounded, yellow, the flagellum about one and one half times the length on the scape, black, the first flagellar joint twice as long as the pedicel, then the joints decrease in size to the fourth, the following six forming a thick oval club with closely articulated joints. Thorax entirely yellow, except the tegulæ which are black, mesonotum finely punctulate, with two rather faintly marked furrows, scutellum large, semicircular, smooth. Metathorax very short, emarginate in the middle, smooth on the sides. Abdomen polished and perfectly smooth, except for coarse longitudinal striæ on the first and at the base of the second segments. The petiole is short quadrate, and bears a quite distinct polished black tubercular horn at its base; basal half of abdomen otherwise yellowish varied with brown, apical half black; third segment longest, second nearly as long, others much shorter. Legs including the coxæ yellow. Wings short, reaching only to the middle of the abdomen. Marginal vein short and swollen, stigmal about one third as long as the lengthened post-marginal, costal margin sparsely ciliated.

Described from one female specimen taken at Woods Hole, Mass., on a slope that was thickly riddled with the burrows of

Halictus. When captured it made no attempt to fly, the wings evidently being too much atrophied to be of functional use.

This form can be readily recognized by its short wings. It does not seem to be very closely related to any of the other North American species.

Scelio ovivorus Riley.

This large and coarsely sculptured Scelionid was originally bred by Scudder from the eggs of the common New England grasshopper (*Dissosteira carolina*) so that its occurrence is evidently not connected with the presence of the *Halictus* colony. Nevertheless it was often seen intermingling with the bees.

Family DIAPRIIDÆ.

Loxotropa ruficornis Ashmead.

This is a common species always to be found on the breeding ground of these bees. Its habits have already been noted in the preceding part of this paper.

Family BETHYLIDÆ.

Empyris subapterus sp. nov.

Female.—Length, 3.25 mm. Black, head and thorax subopaque, abdomen shining; antennæ, mandibles at tips, palpi, tegulæ and extreme tip of abdomen rufous; sparsely pale pubescent. Head about one third longer than wide, closely and finely punctate with fewer larger punctures intermixed. Antennæ reaching about to the tegulæ, scape stout and curved, three times as long as its thickness at the tip; following joints of about equal length, except the first flagellar, which is shorter; pedicel more slender, the other joints slightly wider than long. Eyes hairy, ocelli present. Prothorax sculptured like the head, with a transverse impressed line anteriorly. Mesonotum very short, less than half as long as wide, without grooves or furrows. Tegulæ rufous. Scutellum basally with a deep transverse linear fovea. Metanotum about one and one half times as long as wide, with a median longitudinal carina and a fainter one close on each side of it anteriorly, also a lateral and an apical carina present; surface elsewhere finely transversely rugulose; posterior face sharply declivous, shining and punctulate. Wings abbreviated,¹ just attaining the apex of the metanotum; with a small stigma near the apex, a narrow, submarginal cell and an equally long but wider basal cell; costal margin fringed. Legs, including the coxæ, dull rufous. Abdomen polished black, the margin of the penultimate segment and the apical half of the last segment ferruginous.

¹ For figure see BIOL. BULL., 1903, p. 189, Fig. 2.

Described from several female specimens collected at Woods Holl, Mass., running about among the burrows of a colony of *Halictus pruinosus* Robts.

This species greatly resembles *Mesitius* in habitus, but has a transverse furrow at the base of the scutellum instead of two foveæ. It can hardly be the undescribed female of *E. carbonarius* Ashmead, on account of the difference in the sculpture of the metanotum. It is apparently the first subapterous form to be described in this genus.

Family FORMICIDÆ.

***Lasius niger* Linneus.**

***Stenamma fulvum* var. *piceum* Buckley.**

***Solenopsis molesta* Say.**

This last named species is the only one that derives any direct benefit from the presence of the bees.

Family MUTILLIDÆ.

***Mutilla canadensis* Blake.**

This is the most conspicuous of the enemies of the bees. It has been fully noticed in the preceding part.

***Mutilla infensa* sp. nov.**

Female.—Clothed with sparse appressed white pubescence becoming denser apically, and with scattered long erect hairs. The hairs are black on the vertex, dorsulum and second abdominal segment and become whitish on the under side of the body and beyond the second segment of the abdomen. Coarsely sculptured species; head finely and closely punctate, thorax and petiole of the abdomen coarsely reticulate, abdomen much less deeply and more distantly punctured than the head, the apical segments with finer punctures, meso and metapleuræ shining, not or but little strigose, nearly smooth, pygidium longitudinally closely but irregularly striated, the striæ very weak and vanishing apically. Head quadrate, concave behind, in profile also rounded; eyes prominent, round, subshining, their facets distinct; mandibles straight, strong, pointed, untoothed; scape stout, as long as the three basal joints of the flagellum, basal flagellar joints subequal. Thorax elongate-oval, nearly as broad as the head, the front margin and angles well defined, posterior surface of the metanotum not sharply declivous, somewhat flattened and rounded above. Petiole of the abdomen flattened above, constricted from the second segment, one fourth broader than long, its front angles sharp and prominent, its ventral carina weak,

very obtusely angulate at the middle and minutely toothed in front. Legs slender, provided like the body with silvery erect hairs, four or more strong spines on the outer edge of the hind tibiæ, the tibial spurs and spines black.

Ferruginous or somewhat darker, the mandibles, the flagellum except its basal joint, *i. e.*, the third antennal joint, more or less of the second abdominal segment, and all of the other segments of the abdomen, from the third apically, both ventrally and dorsally black. Legs including the coxæ piceous or black. Second segment of the abdomen with a varying extent of the front margin, a diffused median vitta and the hind margin more strongly black or blackish. On each side of the median stripe is a pair of conspicuous rounded testaceous spots. Last ventral segment sometimes reddish.

Length, 4.75 mm.

Woods Hole, Massachusetts. Parasitic on *Halictus prunosus* (?).

The edentate mandibles, the faceted eyes and the nodose petiole of the abdomen would lead one in placing this species in the small group *scrupæa*, where it is obviously distinct from the only other known female by its rugose thorax, etc. Notwithstanding this, we shall have to disregard the well-marked ommatidia and place the species in the group *occidentalis*, intermediate between *cariniceps* Fox and *rugulosa* Fox, differing from each by the structure of the pygidium, etc., but related by its general habitus, sculpture and chætotaxy.

Mutilla vesta Cresson.

Mutilla ferrugata Fabricius.

Like the former species this too is doubtless parasitic on the larger Hymenoptera such as *Philanthus* or the Pompilidæ that nest near by.¹

Myrmosa unicolor Say.

The males of this species fly about the roadside flowers while the females are frequently found about the bee nests. Their presence is undoubtedly due to the bees.

Family PHILANTHIDÆ.

Philantus punctatus Say.

This species was observed nesting in the very midst of several of the colonies of *Halictus*.

¹ In Europe Sichel records *M. incompleta* Lep. as parasitic on *Halictus* (cf. Horæ, Soc. ent. Ross., VI., p. 11) and *M. coronata* as a parasite of *Larra anathema* (*ibid.*, p. 12).

Sphex ichneumonea Linn., and a species of Pompilidæ were also seen digging their nests in the compact sand of the road in the vicinity of the bee colony. They have no connection with the presence of the bees, but associate with them as the same condition of soil and surroundings are suitable for each.

Order Coleoptera.

Family COCCINELLIDÆ.

Microwisea misella Leconte.¹

The species of this genus are reported to be of great economic importance as they greedily prey on scale insects. The presence of the *Aleyrodes* may have had an influence in bringing this species to our notice.

Family ENDOMYCHIDÆ.

Aphorista vittata Fabricius.

Family PTINIDÆ.

Cænocara scymnoides Leconte.

Family SCAPHIDIDÆ.

Bæocera concolor Fabricius.

The last three species are fungus-eating beetles, which may come to the *Halictus* nests to feed on the fungus overgrowing the stores of abandoned or damp nests. It is certain that during the course of the season numerous nests are left unfinished, either deserted voluntarily by the bees for some whimsical reason or not completed by the death of the bees.

Family RHIPIPHORIDÆ.

Myodites fasciatus Say.

Inasmuch as Fabre and others have found the larvæ and pupæ of a member of this family in the cells of an European species of *Halictus*, it is quite interesting to note the occurrence of *M. fasciatus* about the colonies of the American form. Several specimens were taken while sweeping with the net among the swarming bees as they entered and left their nests.

Several other beetles were found crawling over the nest but were visitants too accidental to record.

¹ This is the species known in our lists under the generic name *Smilia* or *Pentilia*. The present name was proposed by Cockerell (*Can. Ent.*, 1903, p. 38).

In conclusion we may present the following diagram showing the interrelationships of the most important of the insects we have observed. For *Halictus* it is indeed a "whirlpool of life" with only too many vortices centered upon its unfortunate self.

